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COLLECTED SCIENTIFIC PAPERS OF WILLIAM HENRY DINES, B. A., F. R. S.

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By W. R. GREGG

Of the almost countless papers, monographs, notes, etc., that appear from month to month in meteorological journals and elsewhere, only a very few engage our attention beyond a first reading. Many we do not even finish reading. Others we read through, with interest, and perhaps jot down a note or two for future use, then send them to file, whence they are never removed except for dusting.

But every now and then there appears one that holds our interest from beginning to end. We read it a second time. We have it durably bound and place it on our desk for ready reference. It contains a mine of information that we want to be able to consult quickly and frequently. Such a paper is Dines's "The Characteristics of the Free Atmosphere." It was published in 1919 by the British Meteorological Office as Geophysical Memoir No. 13. Since only a few copies were received for the Weather Bureau's use, it was the present reviewer's privilege and pleasure to prepare a rather complete abstract for publication in the MONTHLY WEATHER REVIEW[1] in order that the data and conclusions might be available to all of the Bureau's personnel.

This monograph sums up the results of nearly thirty years' work in investigating the upper air, in the course of which many other papers had been published, either as official documents or in scientific periodicals. These are now presented, for the most part in chronological order, in the "Collected Papers." They form Section II, and are preceded by an introduction by Dines's elder son, L. H. G. Dines. Aside from the "Characteristics," the more important papers in this Section are "The Free Atmosphere in the Region of the British Isles," "Further Contributions to the Investigation of the Upper Air. Total and Partial Correlation Coefficients Between Sundry Variables of the Upper Air," "The Correlation Between Pressure and Temperature in the Upper Air with a Suggested Explanation," and "An Examination of British Upper Air Data in the Light of the Norwegian Theory of the Structure of the Cyclone," this last in collaboration with L. H. G. Dines.

Students of Aerology have always welcomed contributions by W. H. Dines and have wanted to refer to some of them at least, from time to time, since their appearance. But this has been difficult, owing to their being widely scattered in different publications. It is particularly gratifying, therefore, to have them presented in this one volume, which has the added interest of enabling the reader to note the gradual development of Dines's conceptions of the structure of the atmosphere in the light of an ever-increasing body of information, largely accumulated through the efforts of Dines himself. For Dines was a pioneer, not only in analyzing the data but also in planning ways and means for obtaining those data. Even more, he designed and fabricated much of the instrumental and other apparatus used in the observational work. And so it is fitting that Section I of this volume should contain papers under the general heading "Anemometry and Instrument Design." An appreciative introduction is provided by F. J. W. Whipple. Even a mere reading of the titles discloses the wide range of Dines's inventive genius. As Whipple states, he designed instruments "meeting nearly all the needs of the meteorologist." Working often with limited funds and with comparatively crude materials, he produced nevertheless what was needed for the particular job in hand. No time was wasted in realizing a higher degree of precision than the character of the problem warranted. But there was always sufficient accuracy for his purpose. Best known in this country are his pressure tube anemograph and sounding balloon meteorograph. The anemograph forms part of the official instrumental set-up at the central office in Washington, and its records have provided much of value in investigations of gustiness, as applied to aerodynamic problems. The meteorograph is still a standard instrument in Great Britain, and is used elsewhere also. It is inexpensive and light—two desirable qualities in this work in which there is a fairly high percentage of loss and in which the height attained is naturally greater, the lighter the load.

Section III contains Dines's papers on "Radiation," with an introduction by E. Gold. Dines had been giving considerable thought to this subject as early as 1917, but devoted his entire time to it after 1922. Again he was the pioneer, and again, finding no suitable tools to work with, he designed some of his own, notably the ether differential radiometer. Included in the papers here reproduced are "The Heat Balance of the Atmosphere," "Atmospheric and Terrestrial Radiation," and, with L. H. G. Dines as coauthor, "Monthly Mean Values of Radiation from Various Parts of the Sky at Benson, Oxfordshire."

[1] Monthly Weather Review, Vol. 47, September, 1919, pp. 644-647.

In a final Section IV, under the heading "Miscellaneous Papers," with an introduction by R. G. K. Lempert, are grouped those contributions that could not be placed in any of the three larger classifications. Of chief interest, perhaps, are "The Element of Chance Applied to Various Meteorological Problems" and "Climate."

This book is published, as a memorial, by the Royal Meteorological Society. There is a preface by the chairman of the committee, Sir Richard Gregory, and an appreciative tribute by Dines's close friend and coworker, Sir Napier Shaw. Since Dines did not write a book embodying the results of his researches, it is particularly fitting that his contributions to meteorological science, all of them interesting, many of them of permanent value, should be available in one place for the benefit of investigators in this field. Meteorologists generally are indebted and grateful to the Royal Meteorological Society for bringing this about.

A CONTRAST IN THUNDERSTORMS

By W. J. HUMPHREYS

Every one recognizes this contrast as soon as it is mentioned, but no one says anything about it. At any rate it is not generally stressed. The contrast is this: One class of thunderstorms can not develop *without* wind; another class can not develop *with* wind. Promotion of either is prevention of the other.

Vigorous vertical convection of air rich in water vapor is essential to the genesis of any and every thunderstorm. This convection may be mechanically caused, as by a high mountain ridge across the course of the wind, or by cooler air in the path of warmer, the condition along the warm front of a cyclone. More commonly, however, it results from instability induced by cooling above or heating below, or a combination of both. The cooling above is owing chiefly to the importation of relatively cold air, accentuated more or less, especially at night when cloudy, by radiation. The heating below, on the contrary, usually is produced by sunshine, though in some cases importation of warm air is its major if not sole origin.

Two of the great causes of thunderstorms, therefore, are, (*a*) cooling above by the importation of cold air, and (*b*) warming below by insolation. The first is the "cold front" or squall-line thunderstorm, of which there are two classes, the entrapped and the driven; the second, the well-known "heat" thunderstorm. The squall-line storm is induced by a great mass of relatively cold air moving rapidly forward into or crowding against comparatively warm air. Since the velocity of the cold air is much less near the surface than it is at considerable heights, it follows that when the difference in temperature is rather small isolated masses of the warmer air are continually being entrapped by the far overrunning wedge of cooler air, and thereby forced to ascend more or less vigorously. Some of these ascending masses develop thunderstorms. Other squall thunderstorms are caused by the forced ascent of the warm air immediately ahead of the blunt front of the oncoming relatively quite cold air. In none of these cases can the warm air be entrapped or driven to a strenuous convection in front of the cold tip in the free air, except when that cold air is moving forward speedily. If it were moving very slowly it would just spread out gently beneath the warmer air, entrapping none of it, nor compelling a vigorous uprush anywhere. Hence this abundant and impressive class of thunderstorm, induced by cooling above, is caused by winds. A calm would prevent its formation—it can not occur in still air.

The heat thunderstorm, on the other hand, induced by insolation, must have rather quiet air for its genesis. It grows up from small to larger and larger convections of warm air from the surface. To be effective the chimney of warm air thus formed must remain intact and more or less vertical even though it may wander away to a greater or less distance horizontally. Obviously, however, it could neither remain vertical, if formed, nor intact in air that has any considerable horizontal velocity—could not remain vertical because the velocity of every wind varies with height, nor intact because every wind is turbulent, especially in its lower layers.

In short, and in general, thunderstorms incident to cooling above occur only in winds and never in calms, while those incident to heating below form only in calms and never in winds. And these are the greatest classes of thunderstorms—the wind-hatched and the calm-brooded.

BIBLIOGRAPHY

C. FITZHUGH TALMAN, in Charge of Library

RECENT ADDITIONS

The following have been selected from among the titles of books recently received as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies:

Air conditioning engineers handbook. Chicago. [c1932.] v. p. illus. 24½ cm.

American road builders' association.
Snow removal and equipment. Washington. 1931. 20 p. illus. 22½ cm. (Bulletin no. 20.)

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